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ABSTRACT

This study was designed to test the tenability of the following hypothesis: that body weight and displacement are factors to consider when prescribing exercise or assessing physical fitness status. Work output was calculated for each subject on four exercises (situp, pullup, pushup, and vertical jump). There was a significant correlation between maximum repetitions and work output for the pushup, pullup, and situp exercises. These findings, however, did not support the above-stated hypothesis. (PB)

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Title of the report:

A COMPARISON OF THE WORKOUTPUT AND PERFORMANCE MEASURES FOR SELECTED CALESTHENIC EXERCISES PERFORMED TO MAXIMUM

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A COMPARISON OF THE WORK OUTPUT AND PERFORMANCE MEASURES FOR SELECTED CALISTHENIC EXERCISES PERFORMED TO MAXIMUM

Introduction

A subject who performs one repetition of a push-up exercise does not necessarily accomplish the same amount of work as another subject who performs one push-up. The body weight resistance to the effort and the displacement of that weight through a range of movement each contributes to the variation of the amount of work performed for the task. The logical construction of this hypothesis has implications for exercise prescription in the physical education class and for assessing physical fitness status.

The assignment of ten push-ups to a physical education class by a teacher would appear to be an equal prescription of exercise; however, unless each student was the same size, then the work of ten push-ups will vary from student to student. The inequity of this prescription may vary from a maximum effort for the heavy student with long arms to a minimum effort to the light student with short arms.

Physical fitness tests have long employed exercises to measure muscular strength and/or muscle endurance. These tests are generally measured in score units of repetitions which disregard the effect of body weight or displacement on the performance.

This study was designed to test the tenability of the hypothesis by determining the relationship of body weight, displacement of the body weight and repetitions to the work output.

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Method

Four calisthenic exercises were empirically selected for use in the study; they were, the vertical jump, pull-up, push-up and sit-up.

A single group of seventy-four college males enrolled during the summer of 1973 at the University of North Dakota volunteered as subjects for the study.

A battery of anthropometric tests was employed to measure those parameters necessary to the calculation of work output for each of the exercises. Each subject then performed the exercises to maximum by continuous effort.

Test Procedure

Vertical Jump

Work = SBW (lbs.) X Displacement (Ins.)

Performance Score = Standing Reach (Ins.) Jumping Reach (Ins.)

Standing Body Weight

Standing Reach

Jumping Reach

Pull-up

Work = SBW (lbs.) X Displacement (Ins.) X Reps. Max.

Performance Score = Reps. Max.

Pull-up Elbow extended

Pull-up Elbow flexed

Push-up

$$\text{Work} = \frac{\text{BW flex.} + \text{BW ext.}}{2} \times \text{Displacements} \times \text{Reps. Max.}$$

Performance Score = Reps. Max.

Push-up Elbow extended (B.W.)

Push-up Elbow flexed (B.W.)

Push-up Elbow extended (Displacement)

Sit-up

Work = LBW X Sitting Ht. X Reps. Max.

Performance Score = Reps. Max.

Lying Body Wt.

Sitting Height

Results

Estimates for each factor of the four exercises performed by the seventy-four subjects appear in Table 1.

Table 2 illustrates the estimates for the comparisons and the significance of the comparisons between body weight, displacement and repetitions or work for each of the four exercises. The multilinear regression analysis was partitioned into two parts, the first identifying work as the dependant variable and the second with repetitions as the dependant variable.

Since the best of three trials was the measure of the performance score, repetitions were not a part of the analysis for the vertical jump. BW and D each indicated a significant relationship with W, and D indicated the

TABLE 1 MEAN AND STANDARD DEVIATION FOR EACH FACTOR OF THE FOUR EXERCISES PERFORMED BY N = 74 COLLEGE MALES

EXERCISE	FACTOR	MEAN	SD
Vertical Jump	Body Weight	176 lbs.	26.672
	Displacement	16.8 in.	3.175
	Workoutput	249 ft. lbs.	70.541
Pull-Up	Body Weight	176 lbs.	26.672
	Displacement	25.9 in.	2.617
	Repetitions	6	3.729
	Workoutput	2130 ft. lbs.	1212.618
Push-Up	Push-up Weight	127 lbs.	19.214
	Displacement	20.6 in.	1.468
	Repetitions	22	7.369
	Workoutput	4815 ft. lbs.	1871.738
Sit-Up	Sit-up Weight	90 lbs.	17.700
	Displacement	37.3 in.	1.816
	Repetitions	45	19.801
	Workoutput	12450 ft. lbs.	5979.020

TABLE 2 CORRELATION BETWEEN THE BODY WEIGHT (BW) DISPLACEMENT (D) AND REPETITIONS (R) OR WORK (W) FOR EACH OF THE FOUR EXERCISES PERFORMED BY N = 74 COLLEGE MALES

EXERCISE	COMPARISON	CORRELATION	F	SIGNIFICANCE
Vertical Jump	BW+D vs W	.99	3257.	.01
	BW vs D	.18	2.	N.S.
	BW vs W	.68	61.	.01
	D vs W	.84	171.	.01
Pull-Up	BW+D+R vs W	.99	856.	.01
	D+R vs W	.96	452.	.01
	BW+R vs W	.97	547.	.01
	BW+D vs W	.27	3.	N.S.
	BW vs W	-.22	3.	N.S.
	D vs W	.15	2.	N.S.
	R vs W	.94	570.	.01
	BW+D vs R	.44	8.	.01
	BW vs R	-.44	17.	.01
	D vs R	-.05	1.	N.S.
Push-Up	BW+D+R vs W	.99	1382.	.01
	D+R vs W	.93	232.	.01
	BW+R vs W	.98	779.	.01
	BW+D vs W	.30	11.	.01
	BW vs W	.48	22.	.01
	D vs W	.28	6.	.01
	R vs W	.88	251.	.01
	BW+D vs R	.09	1.	N.S.
	BW vs R	.07	1.	N.S.
	D vs R	-.02	1.	N.S.
	BW vs D	.34	9.	.01
Sit-Up	BW+D+R vs W	.99	768.	.01
	D+R vs W	.94	255.	.01
	BW+R vs W	.97	588.	.01
	BW+D vs W	.42	8.	.01
	BW vs W	.42	15.	.01
	D vs W	.20	3.	N.S.
	R vs W	.87	224.	.01
	BW+D vs R	.18	1.	N.S.
	BW vs R	-.01	1.	N.S.
	D vs R	-.17	2.	N.S.
	BW vs D	.46	20.	.01

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higher correlation value of .84.

Body weight and displacement indicated low significant (≐.48) or non-significant correlation estimates with work for pull-ups, push-ups, and sit-ups. Correlation estimates between body weight, displacement and repetitions also were low significant (≐.44) or non-significant. Correlation estimates between repetitions and work, however, were .94 for pull-ups, .88 for push-ups and .87 for sit-ups.

Conclusions

It appears justifiable, then, to conclude that there was a significant correlation between maximum repetitions and workoutput for the push-up, pull-up and sit-up exercises. These findings did not support the hypothesis that body weight and displacement were factors to consider when prescribing exercise or assessing physical fitness status.